

Our society generates large quantities of plastic waste, which has quickly become one of the most significant environmental pollutants, especially due to its long bio-degradation lifecycle. Large quantities of plastic waste find its way into aquatic environments, including lakes, rivers, underground streams and oceans. Every year over 8 million tons of plastic flows into the ocean causing an estimated \$13 Billion damage to marine ecosystems. Microplastic particles (plastic particles and debris with diameters of less than 5mm) constitute by far the largest class of plastic pollution in the open ocean with recent estimates accounting for as much as 90% of all plastic litter.

In 2017, the EPA Trash Free Waters program has conducted a Microplastics Expert Workshop focusing on prioritizing scientific goals and objectives required to understand the harmful impacts of microplastics to human and ecological health. This report concludes with a summary including the identified method needs. Some of such key sought after methods include:

- Methods for microplastics characterization, i.e. by size, shape and chemical composition;
- Methods for microplastics quantification, particularly for particles in the microns scale (i.e. $\geq 1 \mu\text{m}$ and $\leq 1 \text{ mm}$ in size) for which information is limited and which are relevant to human and ecological exposure risks.

Because microplastics objects are small, they are difficult to detect, characterize and quantify in water samples, let alone in the open aquatic environment conditions. Generally, multiple steps are required to first find micro plastic particles, isolate them for analysis, identify and classify in terms of the type of plastics or its chemical composition. For particles smaller than 1mm, different types of microscopy characterization is typically used (e.g. stereo microscopy, Scanning Electron Microscopy, etc.). Once the microplastic particles are detected and counted, the specific type of plastic they are made of can be identified with the use of spectroscopy, atomic force microscopy or fluorescence microscopy methods. However, all of these techniques are extremely low throughput, laborious, expensive, and require expertise to perform and operate. Furthermore, such devices are bulky and not portable, limiting their application to analyzing samples in the laboratory conditions. This creates significant limitations to the use of this microplastics characterization technology and to the types of applications or contexts in which they can be applied.

(b)(4)

(b)(4)



These results have proven the feasibility of the platform to accomplish the tasks of Phase I and have paved the way for completing the final product prototype development in Phase II. During Phase I we have also initiated contacts with prospective industrial partners.